

nibble once at any of these plants. Unfortunately the food plants normally eaten by *luna* were not available for this experiment.

All three larvæ died on the day following hatching and were lost through unavoidable circumstances before a more careful study could be made of them. It is impossible to say whether the small larvæ would have survived for any length of time even if they had fed upon the available food.

It is difficult to attempt any explanation as to why the members of two such widely separated species should mate so readily when confined together. It cannot be explained merely by the desire to mate, without disregarding the presence of female *gloveri* in the same cage. To all appearances there was a definite choice by the male *gloveri* for the *luna* females, although the reason for such a choice is not apparent. Further experimenting and research may serve to throw more light on this problem.

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## BIOLOGICAL NOTES ON *TIMEMA CALIFORNICA* SCUDDER

(Phasmoidea: Timemidæ)

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The genus *Timema* has but two recorded species, neither of which has been reported outside the state of California. *Timema californicum* Scudder is confined to the northern and central parts of the state. The following account of the general features of the biology of this species is not entirely complete since observations have not been carried through a full year, but it is a summary of at least the principal facts concerning its life history and habits.

The second species, *Timema chumash* Hebard, has been reported in southern California. On the basis of present records the two species do not overlap in their distribution.

Specimens of *T. californicum* have been recorded from the San Francisco Bay region, and from as far north as Humboldt County and south to Monterey and Fresno counties. All specimens have been taken from the Chaparral area. The vertical range of distribution is from 1,000 to 6,500 feet, which includes the Chaparral belts. The species has been recorded by other

authors (Essig, Ferris, Hebard) from Fir, Madrone, Deciduous Oaks, Redwood, Manzanita, Pitcher Sage, *Ceanothus*, and *Garrya elliptica*. It apparently feeds on the tender new shoots.

On May 29th, 1935, a trip was made to Loma Prieta Mountain where sixty-seven specimens were taken from *Garrya elliptica*. These were brought into the laboratory and kept alive, the tender hairs on the backs of the leaves and the new spring growth of *Garrya* serving as food. The specimens, however, died during the course of two weeks. In three cases tendencies of cannibalism were found.

A second trip was made on June 8th to Loma Prieta. Thirty-nine specimens were collected (4 immature, 18 adult males, and 17 adult females); eighteen of these were from Manzanita, the rest from *Garrya*. Manzanita proved to be the most successful food in the laboratory, the leaves and the spring bark being used. The plant material in the cages was placed in vials of water and corked with paper toweling. Any drops of excess water which the insects could reach was consumed by them. It appears from this that free water is necessary. The Chaparral regions are for the most part very dry in the summer. The source of water in the natural environment must be from dew and fog which collects on the leaves.

#### HABITS AND LIFE HISTORY

Records of previous studies by other authors show the earliest collecting of *Timema* as about May 18th, and that mating takes place during June and July. A trip was made to Loma Prieta on May 29th. At this time specimens were numerous, over sixty being gathered in the course of two hours. They were gathered by beating the *Garrya elliptica* or Manzanita and picking the fallen insects up from the ground. On August 1st no specimens were found in this same region.

All the females were green with a light yellow lateral line completely around the body; thorax and abdomen with an irregular pattern of green with yellow markings; appendages varying from yellow to rose brown; eyes yellow.

The males were the same green color, but the appendages were rose to brown, deepest in color at the base. Along the dorsal side of the thorax and abdomen dark green and black markings were found. The eyes were blackish. The intensity

of the coloration may vary with each specimen. Five males were found whose ventral side was yellow-green and the dorsal side yellow-brown.

Specimens have been reported which were very pink on the dorsal side and yellow-green on the ventral side.

The female insect is much larger than the male. The living adult female varied in length from 21 to 25 mm. The adult male measured 16 to 17 mm.

No information was obtained as to the number of molts that occur in the life cycle. All specimens gathered were in the last two instars. The latest date known for a specimen to molt into the adult form was June 10th, when one male molted during the night.

*Mating.* Some few days after the males and females reached maturity they were found pairing. The male crawled upon the back of a female. He placed the fore-legs on her meso-thorax the middle legs on the meta-thorax and the hind legs about one-third of the way down the abdomen. The female carried the male about in this manner throughout the mating and egg laying season of six to eight weeks. The male retained this position by hanging on with the tarsal claws. If a pair were forcibly separated they soon joined each other again. The adult female feeds a great deal, the male only occasionally leaves the female's back in search of food.

Copulation takes place during the early part of June. The male slides down the back of the female. The tri-lobed clasper is placed under the genitalic plate and the bi-lobed clasper at the base of the plate on the ventral side. The abdomen of the female is bent to the right and slightly upward. This position is held for several hours. Copulation takes place several times during the egg laying period and at irregular intervals. During copulation the female moves about over the plants.

*Egg Laying.* The first eggs usually appeared about seven days after the first copulation. In one case eggs were produced five days after the first copulation. The eggs are extruded between the valvulæ and held in the cup-like cerci. A fluid is secreted about the egg from the genitalic organs, while it is carefully turned and patted by the cerci. The egg is held by its collar with the tip of the valvulæ. The turning and coating continues for five to ten minutes; when completed the valvulæ re-

lease the egg and it is held in the cerci until the coating is dry and has hardened. When the egg is dry the female may drop it to the ground, but in the majority of cases it is carefully placed on some object. The females deposited many eggs in the folds of the paper toweling which corked the vials, others were placed in the bottom of the cages. Often the female would carry the egg about in search of a proper place to lay it.

The whole process of laying a single egg takes from 12 to 15 minutes; as soon as one egg is deposited a second may be extruded. The number of eggs laid between copulations varied a great deal. Some days only one might be laid, on others five to ten, while often no eggs were laid on a given day. As far as is known, copulation usually takes place at intervals of two to five days during the egg laying period which lasts approximately forty-five days.

*Eggs.* The length of the egg is  $1\frac{1}{2}$ -2 mm. and the width is 1 mm. There is a small micropile at one end and a hard collar-like arrangement at the other. The shell is very tough and hard, but not brittle. The eggs vary in color from tan to brown, resembling the ground in which they are normally deposited. When the eggs are first laid and not completely dry they oftentimes pick up debris which helps to cover and protect them.

*Timema californicum* is a spring and early summer form. The insect presumably passes the late summer and winter in the egg stage and emerges sometime in the spring when the new growth of leaves is developing. Circumstances point to the fact that the span of life is short and that there is only one generation a year.

*Defense.* The tergite of the prothorax is shield-shaped and at each anterior-lateral angle is a darkly pigmented spot which marks the opening of an odoriferous gland. If the insect is suddenly disturbed, a fluid is exuded from this gland. It is not entirely disagreeable but is rather strong.

Each odoriferous gland consists of a large reservoir and a gland which extends almost the entire length of the prothorax just under the hypodermal layer. The gland is pear-shaped and deeply grooved. The walls of the gland proper consist of cells with very large nuclei. The reservoir is irregular and lies between the gland and the body wall. The cells of this structure are large and have small nuclei. The gland and reservoir are



placed among the body muscles, but there are no muscles attached to them, they being held in place by the ligaments of the prothorax. The salivary gland of the same side of the body lies in close contact under the odoriferous gland.

*Parasites.* Two cases of parasitism were found, both involving adult females. A dead female was found with a parasitic round worm extruded from the body. In the other case an immature stage of a mite was found clinging to the thorax, apparently feeding.

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## PROCEEDINGS OF THE PACIFIC COAST ENTOMOLOGICAL SOCIETY

One Hundred and Thirty-sixth Meeting, June 19, 1934

Joint meeting with the Entomological Society of America, American Association of Economic Entomologists, and Lorquin Entomological Club, held at 10 a. m. in Room 113, Agriculture Hall, University of California, Berkeley, California. Members present: E. O. Essig, W. B. Herms, S. B. Freeborn, E. P. Van Duzee, F. E. Blaisdell, V. M. Tanner, R. F. Sternitsky, A. Mead, G. R. Wilson, P. C. Ting, R. E. Blackwelder, H. E. Burke, A. E. Michelbacher, J. Blum, E. G. Linsley, H. H. Keifer, R. L. Usinger, F. H. Wymore, and J. O. Martin. Visitors present as members of other societies: H. A. Scullen, E. D. Ball, R. L. Webster, H. H. Severin, W. C. Cook, J. F. Gates, R. G. Wind, P. Bailey, W. H. Nutting, L. L. Stitt, R. E. Campbell, D. H. DeLeon, W. H. Lange, A. A. Brock, H. M. Armitage, C. E. Cooley, C. F. Roseling, C. W. Woodworth, R. L. Kitchell, E. L. Wampler, J. H. Freitag, C. G. Weigle, J. E. Eckert, S. C. Dorman, J. D. Maple, R. Wall, A. C. Mason, and S. E. Flanders. Professor Essig in the chair.

Dr. Blaisdell read a paper entitled "Some Facts Regarding the Rearing of Tenebrionidæ."

His paper was followed by that of Mr. P. C. Ting, "On a Peculiar Arrangement of the Mouthparts in the Coffee Bean Weevil." Illustrated.

The third paper was read by Prof. E. D. Ball, "The Number of Generations in a season in Leaf Hoppers." Illustrated.

Mr. S. E. Flanders presented an illustrated paper on "A Correlation Between the Feeding Habits and the Development and Degeneration of Ovarian Eggs in Pteromalidæ."

Mr. Charles Woodworth read a paper entitled "The Internal Anatomy of a Wireworm," illustrated by numerous drawings.

The final paper of the program was presented by Mr. F. H. Wymore, on "Observations of the Song of the Cicadidæ."